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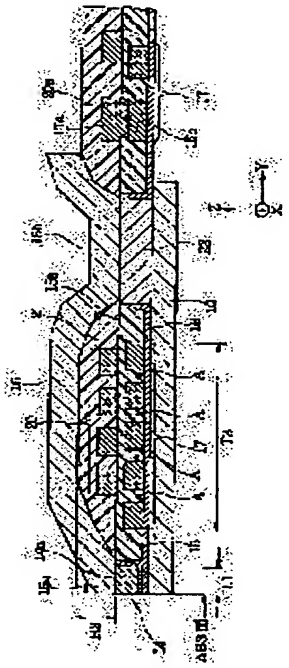
(54) THIN-FILM MAGNETIC HEAD AND ITS MANUFACTURE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a thin-film magnetic head in which the track can be made especially narrow, in which a magnetic path length is made short and an inductance can be reduced, and to provide a manufacturing method of the magnetic head.
SOLUTION: A coil layer 17 as a first layer is formed, in such a way that it is situated on the side of a lower-part core layer 10 from its bonding face 14a to a track-width regulation part 14 in the rear of the track-width regulation part 14. The coil layer is formed as a two-layer structure. The width of the coil layer 17 is reduced, and at the same time, the height up to an insulating layer 21 covering a second coil layer 20 from the lower-part core layer 10 can be increased, the magnetic path can be made short, and the inductance can be reduced.



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* NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] When it has the following and the plane of composition of the aforementioned width-of-recording-track specification part and an up core layer is made into a base plane The coil layer which guides a record magnetic field to the aforementioned lower core layer and the aforementioned up core layer It is located behind the height direction rather than the aforementioned width-of-recording-track specification part, and the upper surface of a coil layer is located in a lower part [base plane / aforementioned] core layer side. An insulating layer is prepared between the aforementioned base plane and the aforementioned lower core layer, and the aforementioned coil layer is embedded to the interior of the aforementioned insulating layer. The thin film magnetic head which it is formed on the aforementioned insulating layer from the upper surface of a width-of-recording-track specification part, applying the aforementioned up core layer, and is characterized by connecting magnetically the end face section of the aforementioned up core layer on a lower core layer. Lower core layer. Up core layer. At least one side with the up magnetic pole layer which has the width-of-recording-track specification part which is located between the aforementioned lower core layer and an up core layer by the opposed face with a record medium and, by which the size of the direction of the width of recording track was regulated, and follows the lower magnetic pole layer which follows a lower core layer, and an up core layer at the aforementioned width-of-recording-track specification part. The gap layer which insulates magnetically one of [between each aforementioned magnetic pole layer or] the aforementioned core layers, and the magnetic pole layer of one of the above.
[Claim 2] The thin film magnetic head according to claim 1 whose aforementioned insulating layer is an inorganic insulating layer.
[Claim 3] the aforementioned insulating layer constitutes a coil layer -- each -- a conductor -- the thin film magnetic head according to claim 1 which consists of an organic insulating layer located between the pitches of the section, and an inorganic insulating layer which fills fields other than between [aforementioned] pitches
[Claim 4] The thin film magnetic head according to claim 1 to 3 by which the wrap insulating layer is made the same field as the aforementioned base plane in the aforementioned coil layer top.
[Claim 5] The thin film magnetic head according to claim 4 by which the 2nd coil layer electrically connected with the aforementioned coil layer is formed through other direct or layers on the aforementioned insulating layer, and an up core layer is formed on a wrap insulating layer in this 2nd coil layer.
[Claim 6] The aforementioned gap layer is the thin film magnetic head according to claim 1 to 5 currently formed with the non-magnetic metal material in which plating formation is possible.
[Claim 7] The aforementioned non-magnetic metal material is the thin film magnetic head according to claim 6 chosen from one sort or two sorts or more in NiP, NiPd, NiW, NiMo, and Au, Pt, Rh, Pd, Ru and Cr.
[Claim 8] The manufacture method of the thin film magnetic head characterized by providing the following. (a) the width-of-recording-track specification part which consists of a lower magnetic pole layer, a nonmagnetic gap layer, and an up magnetic pole layer on a lower core layer, the

width-of-recording-track specification part which consists of the aforementioned lower magnetic pole layer and a nonmagnetic gap layer, or the width-of-recording-track specification part which consists of a nonmagnetic gap layer and a nonmagnetic up magnetic pole layer -- a predetermined width-of-face size -- and the process formed in predetermined length towards the height direction from an opposed face with a record medium (b) It is the process in which the upper surface forms the aforementioned coil layer at this time by forming an insulating ground layer on the aforementioned lower core layer, and forming a coil layer on this insulating ground layer behind [height side] the width-of-recording-track specification part of one of the above so that it may be located in a lower part [upper surface / of the aforementioned width-of-recording-track specification part] core layer side. (c) The process which forms an insulating layer as covers the aforementioned width-of-recording-track specification part and the aforementioned coil layer. (d) The process which carries out flattening of the upper surface of the aforementioned insulating layer so that it may become the upper surface of a width-of-recording-track specification part, and the same field, and the process which applies on the upper shell aforementioned insulating layer of the (e) aforementioned width-of-recording-track specification part, and forms an up core layer.

[Claim 9] The manufacture method of the thin film magnetic head according to claim 8 ground so that an inorganic insulating layer may be formed as an insulating layer in the process of the above (c) and the aforementioned width-of-recording-track specification part and the aforementioned inorganic insulating layer may serve as the same field at the process of the above (d).

[Claim 10] the process of the above (c) -- the aforementioned coil layer -- each -- a conductor -- the manufacture method of the thin film magnetic head according to claim 8 ground so that between the pitches of the section may be fill uped with an organic insulating layer, an inorganic insulating layer may be further formed on the aforementioned organic insulating layer and a coil layer and the aforementioned width-of-recording-track specification part and the aforementioned inorganic insulating layer may serve as the same field at the process of the above (d)

[Claim 11] The manufacture method of the thin film magnetic head according to claim 8 to 10 which includes the following processes of (f) after the process of the above (d). (f) The process which forms the 2nd coil layer electrically connected with the aforementioned coil layer through other direct or layers on the insulating layer by which flattening was carried out [aforementioned], [Claim 12] The manufacture method of the thin film magnetic head according to claim 8 to 11 which carries out plating formation of the aforementioned gap layer with a magnetic pole layer at the process of the above (a).

[Claim 13] The manufacture method of the thin film magnetic head according to claim 8 to 12 which the non-magnetic metal material which forms a gap layer, and in which plating formation is possible chooses from one sort or two sorts or more in NiP, NiPd, NiW, NiMo, and Au, Pt, Rh, Pd, Ru and Cr.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the thin film magnetic head for record used for example, for the surfacing formula magnetic head etc., especially aims at reduction of an inductance, and relates to the thin film magnetic head which can respond to high record frequency-ization, and its manufacture method.
[0002]
[Description of the Prior Art] The partial front view showing the structure of the thin film magnetic head [in / the former / in drawing 18] (inductive head) and drawing 19 are the fragmentary sectional views which looked at the thin film magnetic head cut from 19 -19 line shown in drawing 18 from the arrow.
[0003] The sign 1 shown in drawing 18 and drawing 19 is the lower core layer formed by magnetic materials, such as a permalloy, and the insulating layer 9 is formed on this lower core layer 1.
[0004] It applies in the height direction (the direction of illustration Y) from an opposed face (it is hereafter called a ABS side) with a record medium, and slot 9a in which the inside width method was formed by the width of recording track Tw is formed in the aforementioned insulating layer 9.
[0005] Into this slot 9a, plating formation of the lower magnetic pole layer 3 which connects with the lower core layer 1 magnetically in order of a lower shell, the gap layer 4, and the up magnetic pole layer 5 which connects with the up core layer 6 magnetically is carried out.
[0006] Moreover, as shown in drawing 19 , on the aforementioned insulating layer 9 in the height direction (the direction of illustration Y), the coil layer 7 by which pattern formation was carried out spirally is formed rather than slot 9a formed in the insulating layer 9.
[0007] And the aforementioned coil layer 7 is covered by the organic insulating layers 8, such as a resist, and the up core layer 6 is formed on the aforementioned organic insulating layer 8. The aforementioned up core layer 6 has connected with the up magnetic pole layer 5 magnetically with the lower core layer 1 by end face section 6b in the point 6a again.
[0008] In the inductive head shown in drawing 18 and drawing 19 , if record current is given to the coil layer 7, a record magnetic field will be guided to the lower core layer 1 and the up core layer 6, and a magnetic signal will be recorded on record media, such as a hard disk, by the leak magnetic field from between the up magnetic pole layers 5 which connect with the lower magnetic pole layer 3 and the up core layer 6 which connect with the lower core layer 1 magnetically magnetically.
[0009] In the inductive head shown in drawing 18 and drawing 19 , the lower magnetic pole layer 3 locally formed near the ABS side (opposed face with a record medium) by the width of recording track Tw, the gap layer 4, and the up magnetic pole layer 5 are formed, and this type of inductive head can respond to ** truck-ization.
[0010] If the manufacture method of the inductive head shown in drawing 18 and drawing 19 is explained, an insulating layer 9 will be first formed on the lower core layer 1, and slot 9a of the width of recording track Tw will be formed in the height direction by predetermined length from a

ABS side at the aforementioned insulating layer 9.
[0011] Next, in the aforementioned slot 9a, continuation plating is carried out, the lower magnetic pole layer 3, the gap layer 4, and the up magnetic pole layer 5 are formed, and pattern formation of the coil layer 7 is carried out on the back (the height direction) insulating layer 9 after that than slot 9a formed in the insulating layer 9.
[0012] If the up core layer 6 is formed with frame plating, covering the aforementioned coil layer 7 top by the organic insulating layer 8, and applying it on the aforementioned organic insulating layer 8 from on the up magnetic pole layer 5 furthermore, the inductive head shown in drawing 18 and drawing 19 will be completed.
[0013]
[Problem(s) to be Solved by the Invention] By the way, there is the need of reducing the inductance of an inductive head with ** truck-ization, with future raise in recording density and formation of quantity record frequency.
[0014] In order to aim at reduction of an inductance, the magnetic-path length formed through the up core layer 6 from the lower core layer 1 must be shortened, and, for the reason, there is the need of making small the width-of-face size T1 of the coil layer 7 formed in from point 6a of the up core layer 6 before end face section 6b. If the width-of-face size T1 of the coil layer 7 is made small, the length of the up core layer 6 can be shortened and short magnetic-path-ization can be realized.
[0015] In order to make small the width-of-face size T1 of the aforementioned coil layer 7, without changing the number of turns of the aforementioned coil layer 7, how to make the aforementioned coil layer 7 a two-layer laminated structure can be considered.
[0016] However, it is so difficult that magnetic-path length can be responded to future high record frequency-ization with the structure of the thin film magnetic head shown in drawing 18 and drawing 19 even if it makes the coil layer 7 into a two-layer laminated structure simply to be unable to shorten magnetic-path length but to aim at more suitable reduction of an inductance.
[0017] The reason is that the aforementioned coil layer 7 is formed on the thick insulating layer 9 of thickness. As shown in drawing 18 , the thickness is formed by H5 and the aforementioned thickness H5 of the aforementioned insulating layer 9 is larger than H6 which is the comprehensive thickness of the lower magnetic pole layer 3, the gap layer 4, and the up magnetic pole layer 5. For this reason, as shown in drawing 19 , the coil layer 7 formed on the aforementioned insulating layer 9 will be formed in the upper part [base plane / this] core layer 6 side when the front face of the up magnetic pole layer 5 is made into a base plane.
[0018] Therefore, if the coil layer 7 is simply made into a two-layer laminated structure, even if it can make small the width-of-face size T1 of the aforementioned coil layer 7, since the height of the wrap insulating-layer 8 top becomes large substantially about the coil layer 7 from the lower core layer 1, magnetic-path length cannot be shortened so much after all, and suitable reduction of an inductance cannot be aimed at.
[0019] Moreover, in having made the coil layer 7 into the two-layer laminated structure simply with the inductive head of the structure shown in drawing 19 , the thickness size H1 of the wrap organic insulating layer 8 will become large about the aforementioned coil layer 7, and climax of the aforementioned organic insulating layer 8 at the time of making the front face of the up magnetic pole layer 5 into a base plane will become very large.
[0020] For this reason, it is hard coming to carry out pattern formation of the up core layer 6 formed on the organic insulating layer 8 from on the aforementioned up magnetic pole layer 5, applying with frame plating, and the problem of the aforementioned up core layer 6 that the configuration near point 6a cannot be especially formed in a predetermined configuration occurs.
[0021] this invention aims at offering the thin film magnetic head which it is, and magnetic-path length is shortened and can aim at reduction of an inductance especially with ** truck-ization and its manufacture method for solving the above-mentioned conventional technical problem.
[0022]
[Means for Solving the Problem] The thin film magnetic head in this invention has the width-of-recording-track specification part which is located between the aforementioned lower core layer and an up core layer by the lower core layer, the up core layer, and the opposed face with a

record medium and by which the size of the direction of the width of recording track was regulated. At least one side with the up magnetic pole layer which follows the lower magnetic pole layer which follows a lower core layer, and an up core layer at the aforementioned width-of-recording-track specification part, When it has the gap layer which insulates magnetically one of [between each aforementioned magnetic pole layer or] the aforementioned core layers, and the magnetic pole layer of one of the above and the plane of composition of the aforementioned width-of-recording-track specification part and an up core layer is made into a base plane The coil layer which guides a record magnetic field to the aforementioned lower core layer and the aforementioned up core layer It is located behind the height direction rather than the aforementioned width-of-recording-track specification part, and the upper surface of a coil layer is located in a lower part [base plane / aforementioned] core layer side. An insulating layer is prepared between the aforementioned base plane and the aforementioned lower core layer, and the aforementioned coil layer is embedded to the interior of the aforementioned insulating layer. It is formed on the aforementioned insulating layer from the upper surface of a width-of-recording-track specification part, applying the aforementioned up core layer, and is characterized by connecting magnetically the end face section of the aforementioned up core layer on a lower core layer.

[0023] In this invention, it sets it as the purpose of this invention especially to make the formation position of a coil layer differ from the former, to be able to realize short magnetic-path-ization, and to aim at reduction of an inductance that the thin film magnetic head which can respond to future raise in recording density and quantity record frequency-ization should be manufactured.

[0024] As mentioned above, the coil layer in this invention is behind [height side] the width-of-recording-track specification part formed between the lower core layer and the up core layer, and when the front face of the plane of composition of the aforementioned width-of-recording-track specification part and an up core layer is made into a base plane, it is formed so that it may be located in a lower part [base plane / aforementioned] core layer side. And the aforementioned coil layer is buried inside [which was prepared between the lower core layer and the aforementioned base plane] the insulating layer.

[0025] Thus, according to this invention, the aforementioned coil layer differs from the structure of the inductive head shown in drawing 18 and drawing 19 which are this point, and by which it is buried and formed in the interior of the insulating layer formed behind a width-of-recording-track specification part, and the coil layer 7 is formed on an insulating layer 9.

[0026] Since the height size of a wrap insulating-layer top becomes smaller than before about the aforementioned coil layer from a lower core layer by burying and forming the aforementioned coil layer in the interior of the insulating layer formed behind a width-of-recording-track specification part, compared with the former, the length of an up core layer can be made small, therefore short magnetic-path-ization can be realized, and it is possible to aim at suitable reduction of an inductance.

[0027] Moreover, it is desirable that the aforementioned insulating layer is an inorganic insulating layer in this invention. or the aforementioned insulating layer constitutes a coil layer -- each -- a conductor -- it is desirable to consist of an organic insulating layer located between the pitches of the section and an inorganic insulating layer which fills fields other than between [aforementioned] pitches

[0028] Moreover, it is desirable that the wrap insulating layer is made into the same field as the aforementioned base plane in the aforementioned coil layer top in this invention.

[0029] In this case, it is desirable that the 2nd coil layer electrically connected with the aforementioned coil layer is formed through other direct or layers on the aforementioned insulating layer, and an up core layer is formed on a wrap insulating layer in this 2nd coil layer.

[0030] If a coil layer is formed by the two-layer laminated structure, while width of face of the aforementioned coil layer can be made small as mentioned above, in this invention Since the layer [1st] coil layer is formed in the interior of the insulating layer formed behind a width-of-recording-track specification part, the 2nd coil layer from on a lower core layer the height of a wrap insulating-layer top The magnetic-path length who becomes small compared with the case

where the coil layer of the conventional inductive head is made into a two-layer laminated structure, therefore is formed more through a lower core layer from an up core layer can be shortened, and reduction of an inductance can be aimed at.
[0031] In this invention, as mentioned above, especially the layer [1st] coil layer is buried and formed in the interior of the insulating layer formed behind a width-of-recording-track specification part, and on the same field as the front face of a width-of-recording-track specification part, flattening of the front face of the aforementioned insulating layer is carried out, and it is formed.
[0032] For this reason, the layer [2nd] coil layer (2nd coil layer) formed through other direct or layers on the aforementioned insulating layer can be formed with a sufficient pattern precision.
[0033] By forming a layer [1st] coil layer in the interior of the insulating layer formed behind a width-of-recording-track specification part by this invention furthermore, and forming the 2nd coil layer on the aforementioned insulating layer by which flattening was carried out The coil layer at the time of making the front face of a width-of-recording-track specification part into a base plane climax of a wrap insulating layer It is possible to form an up core layer with a sufficient pattern precision, becoming only a part for climax of a wrap insulating layer about the 2nd coil layer, therefore applying the 2nd coil layer on a wrap insulating layer from on a width-of-recording-track specification part.
[0034] In this invention, as for the aforementioned gap layer, it is desirable to be formed with the non-magnetic metal material in which plating formation is possible, and, as for the aforementioned non-magnetic metal material, it is still more desirable to be chosen from one sort or two sorts or more in NiP, NiPd, NiW, NiMo, and Au, Pt, Rh, Pd, Ru and Cr.
[0035] Moreover, the manufacture method of the thin film magnetic head in this invention (a) The width-of-recording-track specification part which consists of a lower magnetic pole layer, a nonmagnetic gap layer, and an up magnetic pole layer on a lower core layer, Or the width-of-recording-track specification part which consists of the aforementioned lower magnetic pole layer and a nonmagnetic gap layer, The width-of-recording-track specification part which consists of a nonmagnetic gap layer and a nonmagnetic up magnetic pole layer with a predetermined width-of-face size Or and the process formed in predetermined length towards the height direction from an opposed face with a record medium, (b) Behind [height side] the width-of-recording-track specification part of one of the above, an insulating ground layer is formed on the aforementioned lower core layer, and a coil layer is formed on this insulating ground layer. the aforementioned coil layer at this time The process which the upper surface forms so that it may be located in a lower part [upper surface / of the aforementioned width-of-recording-track specification part] core layer side, (c) The process which forms an insulating layer as covers the aforementioned width-of-recording-track specification part and the aforementioned coil layer, (d) It is characterized by having the process which carries out flattening of the upper surface of the aforementioned insulating layer so that it may become the upper surface of a width-of-recording-track specification part, and the same field, and the process which applies on the upper shell aforementioned insulating layer of the (e) aforementioned width-of-recording-track specification part, and forms an up core layer.
[0036] Thus, in this invention, first, since the width-of-recording-track specification part which consists of a magnetic pole layer and a gap layer on a lower core layer is formed in the height direction in predetermined linear dimension from the opposed face with a record medium, the insulating layer 9 shown behind the aforementioned width-of-recording-track specification part at drawing 18 and drawing 19 does not exist, therefore can form a coil layer through an insulating ground layer on the lower core layer behind the aforementioned width-of-recording-track specification part.
[0037] After that, by this invention, it forms on a coil layer from on a width-of-recording-track specification part, applying the insulating layer which consists of an alumina etc., and using CMP technology etc., the front face of the aforementioned insulating layer is deleted to the front face and coplanar of a width-of-recording-track specification part, and the flattening side which becomes the same field top as the front face of a width-of-recording-track specification part is formed in the aforementioned insulating-layer front face.

[0038] And it will be buried in the interior of an insulating layer by the aforementioned coil layer in this case.
[0039] It is impossible to form the coil layer 7 in the interior of an insulating layer 9 on a manufacturing process on the other hand by the thin film magnetic head shown in drawing 18 and drawing 19 .
[0040] That is, since an insulating layer 9 is first formed on the lower core layer 1 by the manufacture method of the thin film magnetic head shown in drawing 18 and drawing 19 , the formation method only has forming the coil layer 7 on an insulating layer 9.
[0041] As mentioned above, it is behind [height side] the width-of-recording-track specification part which was formed between the lower core layer and the up core layer in the coil layer according to the manufacture method of this invention, and when the plane of composition of the aforementioned width-of-recording-track specification part and an up core layer is made into a base plane, it can form so that it may be located in a lower part [base plane / aforementioned] core layer side.
[0042] Moreover, it is desirable to grind so that an inorganic insulating layer may be formed as an insulating layer in the process of the above (c) and the aforementioned width-of-recording-track specification part and the aforementioned inorganic insulating layer may serve as the same field at the process of the above (d) in this invention.
[0043] or -- this invention -- the process of the above (c) -- the aforementioned coil layer -- each -- a conductor -- it is desirable to grind so that between the pitches of the section may be fill uped with an organic insulating layer, an inorganic insulating layer may be further formed on the aforementioned organic insulating layer and a coil layer and the aforementioned width-of-recording-track specification part and the aforementioned inorganic insulating layer may serve as the same field at the process of the above (d) Moreover, it is desirable to include the following processes of (f) after the process of the above (d) in this invention.
[0044] (f) the process which forms the 2nd coil layer electrically connected with the aforementioned coil layer through other direct or layers on the insulating layer by which flattening was carried out [aforementioned] -- by this invention further It is desirable to carry out plating formation of the aforementioned gap layer with a magnetic pole layer at the process of the above (a). In this case, it is desirable that the non-magnetic metal material which forms a gap layer and in which plating formation is possible chooses from one sort or two sorts or more in NiP, NiPd, NiW, NiMo, and Au, Pt, Rh, Pd, Ru and Cr.
[0045]
[Embodiments of the Invention] The partial front view showing the structure of the thin film magnetic head [in / this invention / in drawing 1] and drawing 2 are the fragmentary sectional views which looked at the thin film magnetic head cut from 2-2 line shown in drawing 1 from the arrow.
[0046] Although the thin film magnetic head shown in drawing 1 is an inductive head for record, in this invention, the laminating of the head for reproduction (MR head) which used the magnetoresistance effect for the bottom of this inductive head may be carried out.
[0047] The sign 10 shown in drawing 1 and drawing 2 is the lower core layer formed by magnetic materials, such as a permalloy. In addition, when the laminating of the head for reproduction is carried out to the aforementioned lower core layer 10 bottom, the shield layer which protects a magnetoresistance-effect element from a noise may be prepared separately [the aforementioned lower core layer 10], the aforementioned shield layer may not be prepared, but the aforementioned lower core layer 10 may be operated as an up shield layer of the aforementioned head for reproduction.
[0048] Moreover, as shown in drawing 1 , the inclined planes 10b and 10b which incline in the direction which upper surface 10a of the lower core layer 10 prolonged from the end face of the lower magnetic pole layer 11 mentioned later may be prolonged and formed in the direction parallel to the direction of the width of recording track (the direction of illustration X), or separates from the aforementioned up core layer 16 may be formed. Write-fringing can be further prevented appropriately by inclined planes 10b and 10b being formed in the upper surface of the aforementioned lower core layer 10.

[0049] As shown in drawing 1 , on the lower core layer 10, the width-of-recording-track specification part 14 formed by the width of recording track Tw is formed. As for the aforementioned width of recording track Tw, being formed by 0.7 micrometers or less is desirable, and it is 0.5 micrometers or less more preferably. The thin film magnetic head which can respond to ** truck-ization by this can be manufactured.
[0050] The aforementioned width-of-recording-track specification part 14 is constituted from the laminated structure of three layer membranes of the lower magnetic pole layer 11, the gap layer 12, and the up magnetic pole layer 13 by the example shown in drawing 1 and drawing 2 . Hereafter, the aforementioned magnetic pole layers 11 and 13 and the gap layer 12 are explained.
[0051] As shown in drawing 1 and drawing 2 , on the aforementioned lower core layer 10, plating formation of the lower magnetic pole layer 11 used as the lowest layer of the width-of-recording-track specification part 14 is carried out. The aforementioned lower magnetic pole layer 11 is connected as magnetically as the lower core layer 10, and even if the aforementioned lower magnetic pole layer 11 is formed with the quality of the material which is different also with the same quality of the material as the aforementioned lower core layer 10, whichever is sufficient as it. Moreover, whichever is sufficient even if the monolayer is also formed by the multilayer.
[0052] Moreover, as shown in drawing 1 and drawing 2 , on the aforementioned lower magnetic pole layer 11, the laminating of the nonmagnetic gap layer 12 is carried out.
[0053] It is desirable that the aforementioned gap layer 12 is formed with non-magnetic metal material at this invention, and plating formation is carried out on the lower magnetic pole layer 11. In addition, in this invention, it may be desirable as the aforementioned non-magnetic metal material to choose one sort or two sorts or more in NiP, NiPd, NiW, NiMo, NiRh, and Au, Pt, Rh, Pd, Ru and Cr, and even if the aforementioned gap layer 12 is formed by the monolayer and it is formed by the multilayer, it may be whichever.
[0054] Next, on the aforementioned gap layer 12, plating formation of the up magnetic pole layer 13 which connects with the up core layer 16 mentioned later magnetically is carried out. In addition, the aforementioned up magnetic pole layer 13 may be formed with the same quality of the material as the up core layer 16, and may be formed with the different quality of the material. Moreover, whichever is sufficient even if the monolayer is also formed by the multilayer.
[0055] It enables it to carry out plating formation of the lower magnetic pole layer 11, the gap layer 12, and the up magnetic pole layer 13 continuously, if the gap layer 12 is formed with non-magnetic metal material, as described above.
[0056] In addition, in this invention, the aforementioned width-of-recording-track specification part 14 is not restricted to the laminated structure of the three above-mentioned layer membrane. That is, as long as the aforementioned width-of-recording-track specification part 14 has the gap layer 12 which insulates between each aforementioned magnetic pole layer at least with one side with the up magnetic pole layer 13 which follows the lower magnetic pole layer 11 which follows the lower core layer 10, and the up core layer 16 magnetically, or insulates magnetically one of the aforementioned core layers, and the magnetic pole layer of one of the above, it may be what film composition.
[0057] As described above, moreover, the lower magnetic pole layer 11 and the up magnetic pole layer 13 which constitute the width-of-recording-track specification part 14 Although whichever is sufficient even if each magnetic pole layer is formed with the quality of the material which is different also with the same quality of the material as the core layer connected magnetically, in order to raise recording density As for the lower magnetic pole layer 11 and the up magnetic pole layer 13 which counter the gap layer 12, it is desirable to have saturation magnetic flux density with each magnetic pole layer higher than the saturation magnetic flux density of the core layer connected magnetically. Thus, by having saturation magnetic flux density with high lower magnetic pole layer 11 and up magnetic pole layer 13, a record magnetic field is centralized near the gap and it becomes possible to raise recording density.
[0058] Moreover, as shown in drawing 1 , the thickness size of the aforementioned width-of-recording-track specification part 14 is formed by H4. For example, as an example, the thickness

of the lower magnetic pole layer 11 is [the thickness of about 0.2 micrometers and the up magnetic pole layer 13 of the thickness of about 0.4 micrometers and the gap layer 12] about 2 micrometers.
[0059] Moreover, as shown in drawing 2 , it is formed by linear dimension L1, width-of-recording-track applying [aforementioned / 14] it in the height direction (the direction of illustration Y) from an opposed face (ABS side) with a record medium.
[0060] The aforementioned linear dimension L1 is regulated as a gap depth Gd, and the aforementioned gap depth Gd is beforehand set as predetermined length from having great influence on the electrical property of the thin film magnetic head. In addition, in the example shown in drawing 2 , although the gap depth Gd is decided by the linear dimension L1 of the width-of-recording-track specification part 14, the method using Gd arrangement insulating layer (not shown) as other methods for defining the gap depth Gd can be shown.
[0061] In order to define the gap depth Gd using Gd arrangement insulating layer, the aforementioned Gd arrangement insulating layer is formed on the lower core layer 10, and the length from the front end side of the aforementioned Gd arrangement insulating layer to a ABS side prescribes the gap depth Gd.
[0062] By the way, in this invention, as shown in drawing 1 , it is on the lower core layer 10, and the insulating layer 15 is exposed to an opposed face (ABS side) with a record medium at the both sides of the width-of-recording-track specification part 14.
[0063] The aforementioned insulating layer 15 in this invention should care about the insulating layer 9 exposed to an opposed face with the record medium shown in drawing 18 , and differing in a role (function) here.
[0064] That is, since the insulating layer 9 shown in drawing 18 corresponds to ** truck-ization, it is used, and slot 9a which specifies an inside width method to an opposed face with a record medium as the width of recording track Tw is formed in the aforementioned insulating layer 9. And into the aforementioned slot 9a, plating formation of the lower magnetic pole layer 3, the gap layer 4, and the up magnetic pole layer 5 is carried out.
[0065] Like the insulating layer 9 which is a coil insulation layer used for a wrap sake, and, on the other hand, shows the coil layer (1st coil layer) 17 which shows the insulating layer 15 in this invention to drawing 2 to drawing 18 , the slot which specifies an inside width method as the width of recording track Tw is not necessarily formed.
[0066] Thus, it is possible to form the coil layer 17 according to [that it can have the role with which the insulating layer 15 in this invention differs from the insulating layer 9 shown in drawing 18 originates in the manufacture method mentioned later, and] the manufacture method of this invention, without minding the aforementioned insulating layer 15 on the lower core layer 10.
[0067] In this invention, as shown in drawing 2 , the aforementioned coil layer 17 is behind [height side] the width-of-recording-track specification part 14 (the direction of illustration Y), and when plane-of-composition 14a of the aforementioned width-of-recording-track specification part 14 and the up core layer 16 is made into a base plane, it is formed so that it may be located in the lower part [base plane / aforementioned] core layer 10 side.
[0068] As shown in drawing 2 , between the aforementioned lower core layer 10 and the coil layer 17 The insulating ground layer 18 for the insulating reservation between lower core coil layers is formed. this insulating ground layer 18 For example, it is desirable to be formed by the insulating material which consists of at least one sort in AlO, aluminum 2O3, SiO2 and Ta 2O5, TiO and AlN, AlSiN, TiN and SiN, Si3N4, NiO, WO, WO3, BN and CrN, and SiON.
[0069] And as shown in drawing 2 , on the aforementioned ground insulating layer 18, in volume core 17a, pattern formation was spirally carried out as a center, for example, the coil layers 17, such as Cu, are formed. Moreover, as shown in drawing 2 , the aforementioned coil layer 17 is covered by the insulating layer 15, it exposes even to an opposed face (ABS side) with a record medium, and this insulating layer 15 is formed, as mentioned above (refer to drawing 1).
[0070] Moreover, the aforementioned insulating layer 15 of the example shown in drawing 1 and drawing 2 is an inorganic insulating layer formed by inorganic material, and it is desirable that aluminum 2O3, and SiN and SiO2 to one sort or two sorts or more are chosen as the aforementioned inorganic material.

[0071] Moreover, in this invention, as shown in drawing 2 , on the coil layer 17, pattern formation of the 2nd coil layer 20 is spirally carried out through the inorganic insulating layer 15. Thus, in order to make a coil into a two-layer laminated structure, it is necessary to form hole (contact section) 15b in the wrap inorganic insulating layer 15 for the upper surface of volume core 17a of the coil layer 17 used as the 1st layer, and to connect electrically volume core 20a of the 2nd coil layer 20, and volume core 17a of the coil layer 17 through contact section 15b.
[0072] Moreover, when forming the 2nd coil layer 20, as shown in drawing 2 , it is desirable to carry out flattening of the surface 15a of the wrap inorganic insulating layer 15 on the same field as plane-of-composition 14a of the width-of-recording-track specification part 14, and to form the aforementioned coil layer 17.
[0073] Thus, if flattening of the front face of the inorganic insulating layer 15 is carried out and it is formed, the 2nd coil layer 20 can be formed with a pattern precision sufficient on the aforementioned inorganic insulating layer 15. for this reason, the coil layer 20 of the above 2nd is constituted -- each -- a conductor -- the pitch between the sections can be formed small and it becomes possible to make small the size of coil layer 20 the very thing of the above 2nd In addition, you may carry out pattern formation of the 2nd coil layer 20 through other insulating layers on the aforementioned inorganic insulating layer 15.
[0074] And as shown in drawing 2 , the coil layer 20 of the above 2nd is covered by the insulating layer 21 by organic materials, such as a resist and a polyimide, and pattern formation of the up core layer 16 is carried out on the aforementioned insulating layer 21.
[0075] The point 16a is formed in contact with the width-of-recording-track specification-part 14 top, and the aforementioned up core layer 16 is in the state where end face section 16b was formed on the lower core layer 10 and where the product made from a magnetic material raised and it connected magnetically on the layer 22. In addition, it raises the account of before, and the layer 22 does not need to be formed, and in this case, end face section 16b of the aforementioned up core layer 16 is prolonged even on the lower core layer 10, and it will be in the state where it connected directly magnetically on the lower core layer 10. In addition, as shown in drawing 1 , the width-of-face size T2 of the aforementioned up core layer 16 is formed more greatly than the width of recording track Tw.
[0076] In the inductive head shown in drawing 1 and drawing 2 , if record current is given to the coil layer 17 and the 2nd coil layer 20, a record magnetic field is guided to the lower core layer 10 and the up core layer 16, in the width-of-recording-track specification part 14, it will leak between the lower magnetic pole layer 11 which counters through the gap layer 12, and the up magnetic pole layer 13, a magnetic field will occur, and a magnetic signal will be recorded on record media, such as a hard disk, by this leakage magnetic field.
[0077] By the way, in the inductive head in this invention, although the coil has a two-layer laminated structure, the reason for having made the coil into the two-layer laminated structure makes small the width-of-face size T3 of the coil layer 17, shortens the magnetic-path length formed through the up core layer 16 from the lower core layer 10, aims at reduction of an inductance, and is to manufacture the thin film magnetic head which can respond to the further future high record frequency-ization. When the layer [1st] coil layer 17 is formed by five turns as incidentally shown in drawing 2 , and the 2nd coil layer 20 is formed by four turns, it is checked that the width-of-face size T3 of the aforementioned coil layer 17 can be made small to about 20 micrometers.
[0078] As this invention shows to drawing 2 , and the coil layer 17 used as the 1st layer Since it forms so that it may be located in the lower part [base plane / aforementioned] core layer 10 side when it is behind / height side / the width-of-recording-track specification part 14 and plane-of-composition 14a of the aforementioned width-of-recording-track specification part 14 and the up core layer 16 is made into a base plane The height of the wrap insulating-layer 21 top can be made small for the 2nd coil layer 20 compared with the case where the coil layer of the conventional thin film magnetic head (refer to drawing 19) is made into a two-layer laminated structure, from on the lower core layer 10.
[0079] Therefore, in this invention, short magnetic-path-ization can be realized more appropriately, and an inductance is reduced and can manufacture the thin film magnetic head

which can respond to future high record frequency-ization.
[0080] And the thin film magnetic head in this invention can also respond to ** truck-ization. Although [method / adjustment / of the width of recording track Tw of the width-of-recording-track specification part 14] explained in full detail by the next manufacture method, in this invention, as mentioned above, 0.7 micrometers or less of width of recording track Tw of the aforementioned width-of-recording-track specification part 14 can be preferably formed in 0.5 micrometers or less, and this size is a numeric value below the limitation of the resolution at the time of carrying out exposure development of the resist.
[0081] Moreover, by being formed in the lower part [base plane / aforementioned] core layer 10 side by this invention, when the coil layer 17 makes a base plane plane-of-composition 14a of the width-of-recording-track specification part 14 and the up core layer 16, though the wrap inorganic insulating layer 15 projects from plane-of-composition 14a of the width-of-recording-track specification part 14, and is not formed, and the aforementioned coil layer 17 is projected temporarily and formed, the height is few.
[0082] In the example shown especially in drawing 2 , the coil layer 17 the wrap insulating layer 15 Since flattening of the surface 15a is carried out and it is formed on the same field as plane-of-composition 14a of the width-of-recording-track specification part 14 While pattern formation of the 2nd coil layer 20 formed on the aforementioned insulating layer 15 can be made easy to carry out, there is no height of a wrap insulating layer by the height H2 of the wrap insulating layer 21 about the coil layer 20 of the above 2nd in the coil which rises from plane-of-composition 14a of the aforementioned width-of-recording-track specification part 14.
[0083] Therefore, while according to the thin film magnetic head in this invention magnetic-path length can be shortened and reduction of an inductance can be aimed at, it is possible to form the up core layer 16 formed on an insulating layer 21 from on the width-of-recording-track specification part 14, applying with a sufficient pattern precision.
[0084] In addition, in the example shown in drawing 2 , although the coil is formed with two-layer structure, you may form the aforementioned coil by one layer structure. That is, although the number of turns which doubled the number of turns of the 2nd coil layer 20 used as the number of turns of the coil layer 17 used as the 1st layer and the 2nd layer is 9 in drawing 2 , you may form this number of turns by one layer of the coil layer 17.
[0085] In addition, when considering only as the one-layer coil layer 17, pattern formation of the up core layer 16 will be carried out on the wrap inorganic insulating layer 15 in the aforementioned coil layer 17.
[0086] Although reduction of an inductance cannot be aimed at compared with the case where the width-of-face size T3 of the coil layer 17 formed among end face section 16b from point 16a of the up core layer 16 became long, and a coil is made into a two-layer laminated structure when only the one-layer coil layer 17 is formed, an inductance will be reduced if compared with the case of the inductive head with which the coil layer shown in drawing 19 was formed by one layer.
[0087] Namely, it receives being formed in the lower part [base plane / aforementioned] core layer 10 side, when the coil layer 17 makes a base plane plane-of-composition 14a of the width-of-recording-track specification part 14 and the up core layer 16, as mentioned above in this invention. In the case of the inductive head shown in drawing 19 , when the coil layer 7 is formed on an insulating layer 9 and makes a base plane the plane of composition of the up magnetic pole layer 5 and the up core layer 6, the aforementioned coil layer 7 is formed in the up core layer 6 side rather than the aforementioned base plane.
[0088] Therefore, it is possible for the coil layer 17 to be able to make small the height of the wrap insulating-layer 15 top from on the lower part [case / of the inductive head shown in drawing 19] core layer 10 as for the direction of this invention, to be able to realize short magnetic-path-ization therefore, and to reduce an inductance more appropriately.
[0089] In addition, in forming only the one-layer coil layer 17, the front face of the wrap inorganic insulating layer 15 does not need to be made into the flattening side on the same field as plane-of-composition 14a of the width-of-recording-track specification part 14, and even if the aforementioned insulating layer 15 is rising somewhat and is formed from plane-of-composition

14a of the aforementioned width-of-recording-track specification part 14, it does not care about the aforementioned coil layer 17.
[0090] Next, the thin film magnetic head shown in drawing 3 is the fragmentary sectional view showing other operation gestalten, the thin film magnetic head shown in drawing 3 only differs from the case of the thin film magnetic head the composition of a wrap insulating layer indicates the coil layer 17 to be to drawing 1 , and other composition is the same as the composition of the thin film magnetic head shown in drawing 1 .
[0091] Also in the thin film magnetic head shown in drawing 3 , the width-of-recording-track specification part 14 formed in the height direction (the direction of illustration Y) by the width of recording track Tw in predetermined linear dimension from the opposed face (ABS side) with the record medium on the lower core layer 10 is formed.
[0092] As shown in drawing 3 , it is behind [height side] the aforementioned width-of-recording-track specification part 14, and the coil layer 17 by which pattern formation was carried out spirally is formed in the lower part [a / plane-of-composition 14/ of the width-of-recording-track specification part 14] core layer 10 side.
[0093] The aforementioned coil layer 17 is formed on the lower core layer 10 through the insulating ground layer 18 for the insulating reservation between a lower core layer and a coil layer, and the aforementioned coil layer 17 is covered by the organic insulating layer 23 formed by the organic material to the front face at least. The existing material, such as a resist and a polyimide, is used for the aforementioned organic material.
[0094] thus, the reason for using the insulating layer 23 made from an organic material -- the coil layer 17 -- each -- a conductor -- it is because between the pitches of the section can be filled certainly
[0095] the case where spatter formation of the inorganic insulating layer 15 will be carried out like the example shown in drawing 2 if insulating inorganic material is used for the coil layer 17 as a wrap insulating layer 15 -- the shadow effect etc. -- the aforementioned coil layer 17 -- each -- a conductor -- the cavernous section which an inorganic insulating layer 15 is not appropriately buried between [of the section / A] pitches, and is not buried by the aforementioned inorganic insulating layer 15 between [aforementioned / A] pitches is easy it being formed
[0096] When such the cavernous section is formed, gas collected on the aforementioned cavernous section expands by generation of heat at the time of being the drive of the magnetic head, and there is danger, such as bringing deformation to the film configuration inside the thin film magnetic head.
[0097] thus -- if possible -- the coil layer 17 -- each -- a conductor -- a cavity is made not to be formed between [of the section / A] pitches -- desirable -- this sake -- this invention -- first -- the organic insulating layers 23, such as a resist, -- the coil layer 17 -- each -- a conductor -- between [of the section / A] pitches is filled
[0098] However, don't form the organic insulating layer 23 even in plane-of-composition 14a of the width-of-recording-track specification part 14, and a homotopic. Suppose that it mentions later about the reason.
[0099] And in this invention, as shown in drawing 3 , on the aforementioned coil layer 17 and the organic insulating layer 23, the inorganic insulating layer 15 formed by inorganic material is formed, and this inorganic insulating layer 15 is formed even in plane-of-composition 14a of the width-of-recording-track specification part 14, and the coplanar at least.
[0100] In addition, as mentioned above, aluminum 2O3, and SiN and SiO2 to one sort or two sorts or more are chosen as the inorganic material used as an insulating layer 15.
[0101] Also in the example shown in drawing 3 , pattern formation of the 2nd coil layer 20 is spirally carried out on the aforementioned inorganic insulating layer 15. In addition, surface 15a of the aforementioned inorganic insulating layer 15 has the desirable direction which flattening is carried out and is formed on the same field as plane-of-composition 14a of the width-of-recording-track specification part 14 at the point which can form the coil layer 20 of the above 2nd with a sufficient pattern precision.
[0102] As shown in drawing 3 , the coil layer 20 of the above 2nd is covered by the insulating

layer 21 made from organic materials, such as a resist and a polyimide, and pattern formation of the up core layer 16 is carried out on the aforementioned insulating layer 21. Further, point 16a of the aforementioned up core layer 16 is formed in contact with the width-of-recording-track specification-part 14 top, end face section 16b is formed on the lower core layer 10, and the product made from a **** magnetic material raises it, and it is formed in contact with the layer 22 top.

[0103] The coil layer 17 from which a coil is formed by the two-layer laminated structure, and moreover becomes the 1st layer within the two-layer above also in this example Since it is formed so that it may be located in the lower part [base plane / aforementioned] core layer 10 side when it is behind / height side / the width-of-recording-track specification part 14 and plane-of-composition 14a of the aforementioned width-of-recording-track specification part 14 and the up core layer 16 is made into a base plane While width of face of the aforementioned coil layer 17 can be made small, the 2nd coil layer 20 can make small the height of the wrap insulating-layer 21 top from on the lower core layer 10, therefore magnetic-path length can be shortened, and reduction of an inductance can be aimed at.

[0104] Moreover, it is what can respond to ** truck-ization like the thin film magnetic head shown in drawing 2 also in this example.

[0105] Furthermore, when plane-of-composition 14a of the width-of-recording-track specification part 14 and the up core layer 16 is made into a base plane, since a wrap insulating layer is not so large in the coil layer which projects from the aforementioned base plane, the up core layer 16 can be formed with a sufficient pattern precision.

[0106] Drawing 4 to drawing 10 is a series of manufacturing process views showing the manufacture method of the thin film magnetic head in this invention shown in drawing 2 .

[0107] By drawing 4 , application formation of the resist layer 24 is first carried out on the lower core layer 10. The thickness size H3 of the aforementioned resist layer 24 must be formed more thickly than the thickness size H4 of the width-of-recording-track specification part 14 in the completed thin film magnetic head which is shown in drawing 1 at least.

[0108] Next, from an opposed face with a record medium, in the height direction (the direction of illustration Y), it is predetermined linear dimension, and slot 24a formed with a predetermined width-of-face size in the direction of the width of recording track (the direction of illustration X) is formed, and the width-of-recording-track specification part 14 is formed in the aforementioned slot 24a by exposure development at the aforementioned resist layer 24.

[0109] As shown in drawing 4 , the aforementioned width-of-recording-track specification part 14 consists of a lower shell lower magnetic pole layer 11, a gap layer 12, and an up magnetic pole layer 13, and plating formation of these each class is carried out continuously.

[0110] In addition, the film composition of the width-of-recording-track specification part 14 formed in the aforementioned slot 24a is not restricted to the composition of the three above-mentioned layers. That is, as long as the aforementioned width-of-recording-track specification part 14 is constituted from a gap layer 12 located between aforementioned one core layer, aforementioned one [which counters at this] magnetic pole layer, or both the magnetic pole layer by the up magnetic pole layer 13 which follows the lower magnetic pole layer 11 and/or up core layer which follow the lower core layer 10, and the row, it may be what film composition.

[0111] Moreover, as mentioned above, it is desirable to carry out plating formation of the aforementioned gap layer 12 with a magnetic pole layer, and it is desirable that the non-magnetic metal material which forms the gap layer 12 in this case and in which plating formation is possible chooses from one sort or two sorts or more in NiP, NiPd, NiW, NiMo, and Au, Pt, Rh, Pd, Ru and Cr.

[0112] Thereby, continuation plating can be carried out and the lower magnetic pole layer 11, the gap layer 12, and the up magnetic pole layer 13 can be formed.

[0113] Moreover, by exposure development, hole 24b is formed, into this hole 24b, the product made from a magnetic material raises and plating formation of the layer 22 is carried out at the height direction (direction of illustration Y) back end of the aforementioned resist layer 24.

[0114] At the process shown in drawing 5 , on the aforementioned lower core layer 10, the state where the aforementioned resist layer 24 was removed is shown, the width-of-recording-track

specification part 14 is formed near a ABS side, it raises in the position distant from the aforementioned width-of-recording-track specification part 14 in the height direction, and the layer 22 is formed.
[0115] In addition, the both-sides side (side in the direction of illustration X) of the width-of-recording-track specification part 14 shown in drawing 5 can be deleted from the width of recording track by ion milling (the direction of illustration X), and the width-of-face size of the aforementioned width-of-recording-track specification part 14 can also be made small. The width-of-face size of the width-of-recording-track specification part 14 deleted by this ion milling is specified as the width of recording track Tw.
[0116] In addition, by the aforementioned ion milling, the upper surface of the lower core layer 10 of the direction of the width of recording track (the direction of illustration X) prolonged from the end face of the lower magnetic pole layer 11 can also be deleted, and the inclined planes 10b and 10b as shown in drawing 1 are formed in the lower core layer 10 aforementioned upper surface.
[0117] next -- the process shown in drawing 6 -- the lower core layer from the width-of-recording-track specification part 14 -- 10 top, it raises further, it applies in the height direction from a layer 22, and spatter formation of the insulating ground layer 18 formed by the insulating material is carried out
[0118] And as shown in drawing 6 , volume core 17a of a coil is formed on the insulating ground layer 18 which raised and was formed in the back end side rather than the layer 22, and pattern formation of the coil layer 17 is carried out spirally a center [the aforementioned volume core 17a].
[0119] In addition, in this invention, in the case of the coil layer 17 aforementioned formation, the aforementioned coil layer 17 is formed so that it may be located in the lower part [a / plane-of-composition 14/ of the width-of-recording-track specification part 14] core layer 10 side.
[0120] Next, at the process shown in drawing 7 , it is a wrap by the insulating layer 15 about the coil layer 17 top. In addition, in this case, it reaches on the width-of-recording-track specification part 14, and raises, and a layer 22 top is also covered by the aforementioned insulating layer 15.
[0121] In addition, in this invention, spatter formation of the aforementioned insulating layer 15 is carried out by inorganic material. It is desirable to choose one sort or two sorts or more as the aforementioned inorganic material from from aluminum 2O3 and among SiN and SiO2.
[0122] And as shown in drawing 7 , the front face of the aforementioned inorganic insulating layer 15 is deleted using CMP technology etc. on the B-B line which is made to expose the front face of the width-of-recording-track specification part 14, and the coil layer 17 does not expose. Drawing 8 shows the state.
[0123] As shown in drawing 8 , in the coil layer 17 formed through the insulating ground layer 18 on the lower core layer 10, it will be completely covered by the inorganic insulating layer 15.
[0124] Moreover, by the above-mentioned CMP method, by plane-of-composition 14a of the width-of-recording-track specification part 14, and the coplanar, flattening of the surface 15a of the aforementioned inorganic insulating layer 15 is carried out, and it is formed.
[0125] In addition, at the process shown in drawing 8 , hole (contact section) 15b is formed in the wrap insulating layer 15 for the volume core 17a top of the coil layer 17.
[0126] Next, at the process shown in drawing 9 , pattern formation of the 2nd coil layer 20 is spirally carried out on the aforementioned inorganic insulating layer 15. Since contact section 15b is formed on the volume core 17a at the layer [1st] coil layer 17 as mentioned above, volume core 20a of the 2nd coil layer 20 is electrically connected on volume core 17a of the coil layer 17 through the aforementioned contact section 15b.
[0127] Moreover, as mentioned above, since flattening of the surface 15a of the wrap inorganic insulating layer 15 is carried out in the coil layer 17 and it is formed, it is possible to form the 2nd coil layer 20 with a sufficient pattern precision on the aforementioned inorganic insulating layer 15.
[0128] And as shown in drawing 9 , the coil layer 20 of the above 2nd is covered by the insulating layer 21 formed by organic insulating materials, such as a resist and a polyimide, and at

the process further shown in drawing 10 , pattern formation of the up core layer 16 is carried out by the existing methods, such as frame plating, on the aforementioned insulating layer 21. As shown in drawing 10 , the aforementioned up core layer 16 was formed in contact with the width-of-recording-track specification-part 14 top in the point 16a, and was formed on the lower core layer 22 in end face section 16b, is raised, on a layer 22, touches magnetically and is formed.

[0129] Next, the manufacture method of the thin film magnetic head shown in drawing 3 is explained below using a series of process drawings shown in drawing 11 or drawing 17 .

[0130] By drawing 11 , application formation of the resist layer 24 is first carried out on the lower core layer 10. The thickness size H3 of the aforementioned resist layer 24 must be formed more thickly than the thickness size H4 of the width-of-recording-track specification part 14 in the completed thin film magnetic head which is shown in drawing 1 .

[0131] Next, from an opposed face with a record medium, in the height direction (the direction of illustration Y), it is predetermined linear dimension, and slot 24a formed with a predetermined width-of-face size in the direction of the width of recording track (the direction of illustration X) is formed, and the width-of-recording-track specification part 14 is formed in the aforementioned slot 24a by exposure development at the aforementioned resist layer 24.

[0132] The aforementioned width-of-recording-track specification part 14 consists of a lower shell lower magnetic pole layer 11, a gap layer 12, and an up magnetic pole layer 13, and plating formation of these each class is carried out continuously.

[0133] In addition, the film composition of the width-of-recording-track specification part 14 formed in the aforementioned slot 24a is not restricted to the composition of the three above-mentioned layers. That is, as long as the aforementioned width-of-recording-track specification part 14 is constituted from a gap layer 12 located between aforementioned one core layer, aforementioned one [which counters at this] magnetic pole layer, or both the magnetic pole layer by the up magnetic pole layer 13 which follows the lower magnetic pole layer 11 and/or up core layer which follow the lower core layer 10, and the row, it may be what film composition.

[0134] Moreover, it is desirable to carry out plating formation of the aforementioned gap layer 12 with a magnetic pole layer, and it is desirable that the non-magnetic metal material which forms the gap layer 12 in this case and in which plating formation is possible chooses from one sort or two sorts or more in NiP, NiPd, NiW, NiMo, and Au, Pt, Rh, Pd, Ru and Cr.

[0135] Thereby, continuation plating can be carried out and the lower magnetic pole layer 11, the gap layer 12, and the up magnetic pole layer 13 can be formed.

[0136] Moreover, by exposure development, hole 24b is formed, into this hole 24b, the product made from a magnetic material raises and plating formation of the layer 22 is carried out at the back end section of the aforementioned resist layer 24.

[0137] At the process shown in drawing 12 , on the aforementioned lower core layer 10, the state where the aforementioned resist layer 24 was removed is shown, the width-of-recording-track specification part 14 is formed near a ABS side, it raises in the position distant from the aforementioned width-of-recording-track specification part 14 in the height direction, and the layer 22 is formed.

[0138] In addition, the both-sides side (side in the direction of illustration X) of the width-of-recording-track specification part 14 shown in drawing 12 can be deleted from the width of recording track by ion milling (the direction of illustration X), and the width-of-face size of the aforementioned width-of-recording-track specification part 14 can also be made small. The width-of-face size of the width-of-recording-track specification part 14 deleted by this ion milling is specified as the width of recording track Tw.

[0139] In addition, by the aforementioned ion milling, the upper surface of the lower core layer 10 of the direction of the width of recording track (the direction of illustration X) prolonged from the end face of the lower magnetic pole layer 11 can also be deleted, and the inclined planes 10b and 10b as shown in drawing 1 are formed in the lower core layer 10 aforementioned upper surface.

[0140] next -- the process shown in drawing 13 -- the lower core layer from the width-of-recording-track specification part 14 -- 10 top, it raises further, it applies in the height direction

from a layer 22, and spatter formation of the insulating ground layer 18 formed by the insulating material is carried out
[0141] And as shown in drawing 13 , volume core 17a of a coil is formed and pattern formation of the coil layer 17 is carried out spirally a center [the aforementioned volume core 17a].
[0142] In addition, in this invention, in the case of the coil layer 17 aforementioned formation, the aforementioned coil layer 17 is formed so that it may be located in the lower part [a / plane-of-composition 14/ of the width-of-recording-track specification part 14] core layer 10 side.
[0143] and -- this invention -- the aforementioned coil layer 17 -- each -- a conductor -- between [of the section / A] pitches is filled with the organic insulating layer 23 formed by organic materials, such as a resist and a polyimide
[0144] although the organic insulating layer 23 was not used, but it was accepted inorganic insulating-layer 15, it came out and the coil layer 17 is covered in the thin film magnetic head shown in drawing 2 , as shown in process drawing of drawing 7 -- such -- the inorganic insulating layer 15 -- the coil layer 17 -- each -- a conductor -- between [of the section / A] pitches is not appropriately filled by the aforementioned inorganic insulating layer 15, but there is a danger that the cavernous section will be formed between [aforementioned / A] pitches thus -- the process shown in drawing 13 in order that the reason the cavernous section is formed may be that the aforementioned inorganic insulating layer 15 is formed by the spatter and may lose formation of such the cavernous section -- first -- the aforementioned coil layer 17 -- each -- a conductor -- organic materials, such as a resist, were applied between [of the section / A] pitches, and the aforementioned organic insulating layer 23 has closed between [A] pitches completely
[0145] After being filled up with the aforementioned organic insulating layer 23 between [A] pitches, the postbake (heat treatment) of the aforementioned organic insulating layer 23 is carried out, and it is hardened.
[0146] And as the process of drawing 14 shows, it is a wrap by the inorganic insulating layer 15 about the aforementioned coil layer 17 top. In addition, in this case, it reaches on the width-of-recording-track specification part 14, and raises, and a layer 22 top is also covered by the aforementioned inorganic insulating layer 15.
[0147] by the way, it mentioned above -- as -- the organic insulating layer 23 -- the coil layer 17 -- each -- a conductor -- it must not be used in order to fill between [of the section / A] pitches, and don't replace with the inorganic insulating layer 15, and don't form the organic insulating layer 23 to an inorganic insulating-layer 15 formation position
[0148] In case the reason is it polish processing that the aforementioned insulating layer is the organic insulating layer 23 in case an insulating layer is deleted by the CMP method performed to a degree, by peculiar stickiness which an organic material has since polish processing cannot be given appropriately -- it is -- therefore -- this invention -- the organic insulating layer 23 -- the coil layer 17 -- each -- a conductor -- it uses only in order to fill between [of the section / A] pitches, and the inorganic insulating layer 15 is formed in the portion ground by the CMP method
[0149] And as shown in drawing 14 , the front face of the aforementioned inorganic insulating layer 15 is deleted on the B-B line using CMP technology etc., and the front face of the width-of-recording-track specification part 14 is exposed. Drawing 15 shows the state.
[0150] the coil layer 17 formed on the lower core layer 10 as shown in drawing 15 , and the aforementioned coil layer 17 -- each -- a conductor -- in the insulating layer 23 made from an organic material which fills between [of the section / A] pitches, it will be completely covered by the insulating layer 15 made from inorganic material
[0151] Moreover, by the above-mentioned CMP method, by plane-of-composition 14a of the width-of-recording-track specification part 14, and the coplanar, flattening of the surface 15a of the aforementioned inorganic insulating layer 15 is carried out, and it is formed.
[0152] In addition, at the process shown in drawing 15 , hole (contact section) 15b is formed in the wrap inorganic insulating layer 15 for the volume core 17a top of the coil layer 17.
[0153] Next, at the process shown in drawing 16 , pattern formation of the 2nd coil layer 20 is spirally carried out on the aforementioned inorganic insulating layer 15. Since contact section

15b is formed on the volume core 17a at the aforementioned coil layer (1st coil layer) 17 as mentioned above, volume core 20a of the 2nd coil layer 20 is electrically connected on volume core 17a of the coil layer 17 through the aforementioned contact section 15b.
[0154] Moreover, as mentioned above, since it is formed, the thing which was done in the coil layer 17 for flattening of the surface 15a of the wrap inorganic insulating layer 15 and which form the 2nd coil layer 20 with a sufficient pattern precision on the aforementioned inorganic insulating layer 15 is possible.
[0155] And as shown in drawing 16 , the coil layer 20 of the above 2nd is covered by the insulating layer 21 formed by organic insulating materials, such as a resist and a polyimide, and at the process further shown in drawing 17 , pattern formation of the up core layer 16 is carried out by the existing methods, such as frame plating, on the aforementioned insulating layer 21. As shown in drawing 17 , the aforementioned up core layer 16 was formed in contact with the width-of-recording-track specification-part 14 top in the point 16a, and was formed on the lower core layer 22 in end face section 16b, is raised, on a layer 22, touches magnetically and is formed.
[0156] As mentioned above, by this invention, although the manufacture method of the thin film magnetic head of this invention shown in drawing 2 and drawing 3 was explained, since the resist layer 24 is used and the width-of-recording-track specification part 14 is first formed on the lower core layer 10 as mentioned above, in case the coil layer 17 is formed at a next process, it is in the state where nothing is formed on the lower core layer 10 which should form the aforementioned coil layer 17.
[0157] For this reason, the aforementioned coil layer 17 can be formed through the insulating ground layer 18 of thin thickness on the lower core layer 10, and when plane-of-composition 14a of the aforementioned width-of-recording-track specification part 14 is made into a base plane, you can make it to be height side back from the width-of-recording-track specification part 14 about the aforementioned coil layer 17, and located in the lower part [base plane / aforementioned] core layer 10 side in this invention.
[0158] Therefore, if a coil is formed by the two-layer laminated structure like this invention, while the width-of-face size of the aforementioned coil layer can be made small, the 2nd coil layer 20 can make small the height of the wrap insulating-layer 21 top from on the lower core layer 10, and short magnetic-path-ization can be attained appropriately.
[0159] Moreover, while the climax of the aforementioned coil layer when making plane-of-composition 14a of the width-of-recording-track specification part 14 into a base plane does not change so greatly, therefore shortens magnetic-path length in this invention and aims at reduction of an inductance, it can form the up core layer 16 with a sufficient pattern precision.
[0160] In addition, by this invention, you may form a coil by one layer structure. In this case, after forming the coil layer 17 with the predetermined number of turns, it is the process shown in drawing 8 and drawing 19 , next if the up core layer 16 is formed, the thin film magnetic head will be completed.
[0161] Moreover, by this invention, it is also possible to delete the both-sides end face of the direction of the width of recording track of the width-of-recording-track specification part 14 formed on the lower core layer 10 by the ion milling method at the process shown in drawing 5 and drawing 12 , therefore by this invention, the width-of-face size (= width of recording track Tw) of the aforementioned width-of-recording-track specification part 14 can be formed small, and the thin film magnetic head which can respond to ** truck-ization can be manufactured. In addition, it is desirable to specifically form the width of recording track Tw of the aforementioned width-of-recording-track specification part 14 by 0.7 micrometers or less, and it is 0.5 micrometers or less more preferably.
[0162]
[Effect of the Invention] When according to this invention explained in full detail above it is the height direction back from a width-of-recording-track specification part about a coil layer and the plane of composition of the aforementioned width-of-recording-track specification part and an up core layer is made into a base plane It becomes possible to form an up core layer with a sufficient pattern precision at the same time the aforementioned coil layer can make small the

height size of a wrap insulating-layer top from on a lower core layer, it shortens magnetic-path length and it aims at reduction of an inductance, since it forms so that it may be located in a lower part [base plane / aforementioned] core layer side.
[0163] It can be desirable especially to make the aforementioned coil layer into a two-layer laminated structure by this invention, it can make small the width-of-face size of a coil layer by considering as a two-layer laminated structure, can shorten magnetic-path length more, and an inductance can be reduced. Even if it is the case where it is made a two-layer laminated structure, moreover, the layer [1st] coil layer Since it is formed so that it may be located in a lower part [base plane / aforementioned] core layer side when the plane of composition of the aforementioned width-of-recording-track specification part and an up core layer is made into a base plane as mentioned above A coil layer (layer [2nd] coil layer) can make small the height size of a wrap insulating-layer top from on a lower core layer. While magnetic-path length can be shortened more, climax of a wrap insulating layer can form an up core layer with a sufficient pattern precision for a coil layer so greatly from the aforementioned base plane.
[0164] Furthermore, in the thin film magnetic head in this invention, the width of recording track Tw of a width-of-recording-track specification part can be formed possible [correspondence in the formation of a ** truck], and, simultaneously with a raise in recording density, the thin film magnetic head which can respond to high record frequency-ization can be manufactured by reduction of an inductance in this way at this invention.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Partial front view showing the structure of the thin film magnetic head in this invention,
[Drawing 2] The fragmentary sectional view of the thin film magnetic head cut from 2-2 line shown in drawing 1 ,
[Drawing 3] The fragmentary sectional view showing the structure of other thin film magnetic heads in this invention,
[Drawing 4] 1 process drawing showing the manufacture method of the thin film magnetic head shown in drawing 2 of this invention,
[Drawing 5] 1 process drawing carried out to the degree of the process shown in drawing 4 ,
[Drawing 6] 1 process drawing carried out to the degree of the process shown in drawing 5 ,
[Drawing 7] 1 process drawing carried out to the degree of the process shown in drawing 6 ,
[Drawing 8] 1 process drawing carried out to the degree of the process shown in drawing 7 ,
[Drawing 9] 1 process drawing carried out to the degree of the process shown in drawing 8 ,
[Drawing 10] 1 process drawing carried out to the degree of the process shown in drawing 9 ,
[Drawing 11] 1 process drawing showing the manufacture method of the thin film magnetic head shown in drawing 3 of this invention,
[Drawing 12] 1 process drawing carried out to the degree of the process shown in drawing 11 ,
[Drawing 13] 1 process drawing carried out to the degree of the process shown in drawing 12 ,
[Drawing 14] 1 process drawing carried out to the degree of the process shown in drawing 13 ,
[Drawing 15] 1 process drawing carried out to the degree of the process shown in drawing 14 ,
[Drawing 16] 1 process drawing carried out to the degree of the process shown in drawing 15 ,
[Drawing 17] 1 process drawing carried out to the degree of the process shown in drawing 16 ,
[Drawing 18] Partial front view showing the structure of the thin film magnetic head in the former,
[Drawing 19] The fragmentary sectional view of the thin film magnetic head cut from 19 -19 line shown in drawing 18 ,
[Description of Notations]
10 Lower Core Layer
11 Lower Magnetic Pole Layer
12 Gap Layer
13 Up Magnetic Pole Layer
14 Width-of-Recording-Track Specification Part
15 Insulating Layer (Inorganic Insulating Layer)
16 Up Core Layer
17 Coil Layer
18 Insulating Ground Layer
20 2nd Coil Layer
21 Insulating Layer
23 Insulating Layer (Organic Insulating Layer)
24 Resist Layer

[Translation done.]